

Petschenga Lake and District, July 3rd and 12th, 1899.

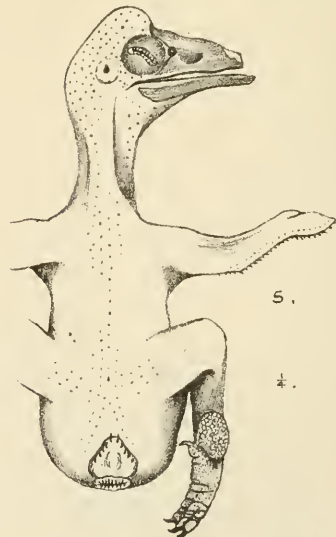
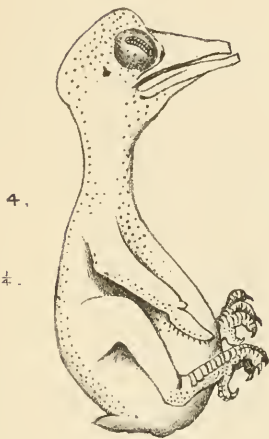
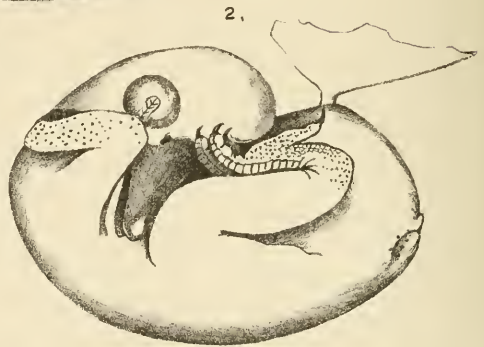
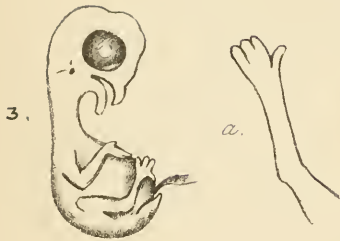
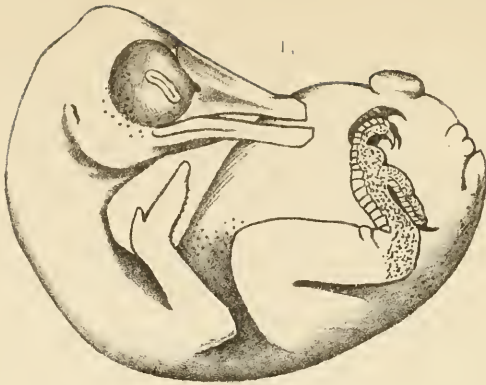
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|-----------------------------|---------------------------|
| 1. Redwing. | 22. Osprey. |
| 2. Fieldfare. | 23. Whooper Swan. |
| 3. Wheatear. | 24. Wigeon. |
| 4. Redstart. | 25. Long-tailed Duck. |
| 5. Willow-Wren. | 26. Common Scoter. |
| 6. Siberian Tit. | 27. Velvet Scoter. |
| 7. White Wagtail. | 28. Goosander. |
| 8. Grey-headed Wagtail. | 29. Merganser. |
| 9. Meadow-Pipit. | 30. Capercaillie. |
| 10. Red-throated Pipit. | 31. Willow-Grouse. |
| 11. Sand-Martin (?). | 32. Dotterel. |
| 12. Brambling. | 33. Ringed Plover. |
| 13. Coues's Redpoll. | 34. Golden Plover. |
| 14. Reed-Bunting. | 35. Common Sandpiper. |
| 15. Shore-Lark. | 36. Redshank. |
| 16. Hooded Crow (?). | 37. Whimbrel. |
| 17. Three-toed Woodpecker. | 38. Arctic Tern. |
| 18. Cuckoo. | 39. Common Gull. |
| 19. Hawk-Owl. | 40. Buffon's Skua. |
| 20. Rough-legged Buzzard. | 41. Black-throated Diver. |
| 21. White-tailed Eagle (?). | |

XLV.—*On some Hornbill Embryos and Nestlings.* By R. SHELFORD, B.A. (Curator of the Sarawak Museum). *With Field-notes by C. HOSE.*

(Plates VIII.-X.)

THE material forming the subject of this paper consists of one 14-days-old embryo of *Anthracoceros malayanus* (Stage 1); a nearly ripe embryo of *Buceros rhinoceros*, another of *Rhytidoceros undulatus* (Stage 2); one newly-hatched nestling of *B. rhinoceros*, two (of approximately the same age) of *R. undulatus* (Stage 3); a six-weeks-old nestling of *B. rhinoceros* (Stage 4); and two young specimens of *A. malayanus*, just capable of flight (Stage 5).

I am indebted to Mr. G. J. Sands, Government Planter, for presenting me with the embryo and nestlings of *R. undulatus*, and to Mr. C. Hose, Resident of Baram, for the loan of all the rest of the material. To both these gentlemen I herewith beg to tender my most grateful thanks.



Stage 1.—14-days-old embryo of *Anthracoceros malayanus*. (Pl. VIII. figs. 3 & 3 a.)

The disposition of the toes is the only external feature which calls for much notice. The hallux is well separated from the other digits, but has not yet taken up the backward position characteristic of the Bucerotidæ; it still points forward and inward. The other digits are still united to each other throughout the greater part of their length, the third being a trifle the longest. The plantar surface of the foot is directed outward. There are no traces of feathers, save on the border of the pygidium, where one may perceive eight minute papillæ, marking the point of exit of the rectrices. The pygidium is acutely pointed and long.

Dimensions (in millimetres).—Total length 28; upper mandible 2; lower mandible 5·3; antebrachium 5; manus 4; tibia 6·2; foot and tarso-metatarsus 5·5.

Stage 2.—Nearly ripe embryos of *Buceros rhinoceros* and *Rhytidoceros undulatus*. (Pl. VIII. figs. 1 & 2.)

Buceros rhinoceros.—The most striking feature of the embryo is its absolute nakedness; a few feather-papillæ may be distinguished with difficulty round the angle of the gape and behind the eye, on the lower part of the back and on the chest, but it is impossible to define very accurately their exact extent. The rectrices and remiges are still invisible, minute depressions marking their future points of emergence. The nostril lies close under the eye and is very small. The upper mandible is large, but no trace of the huge epithema of the adult is yet to be seen. Anteriorly it is sharply ridged and abruptly truncated: a slight depression occurs just before the tip; the sharp edge of the extreme tip must act as an egg-tooth, no actual egg-tooth being present. The lower mandible projects somewhat beyond the upper; its upper margin is slightly sinuous, and on its extreme anterior edge is a minute papilla.

The eye-opening is bounded by fleshy, finely-wrinkled eyelids. The cloacal lips are remarkably prominent, but the opening of the oil-gland is not visible; the pygidium is much

more rounded than was the case in Stage 1. The foot is very slightly flattened laterally; the two-jointed hallux is now completely turned backward, as in the adult; the third digit is the longest. Dorsally the digits and "tarsus" are covered with one row of rectangular scutes, ventrally with granular scales, smallest on the sole and on the somewhat swollen "heel" (junction of tibia and tarso-metatarsus).

Dimensions.—Total length 157; upper mandible (to nostril) 14; lower mandible (to gape) 23; neck 44; antebrachium 16; manus 14; tibia 21; tarso-metatarsus 16; 3rd digit 7.5.

Rhytidoceros undulatus.—A slightly older embryo than that just described, but the differences between the two are very slight. The position of the embryo in the egg is shown in the figure; each manus is bent at right angles to the cubitus and lies under the throat, their tips almost touching; the right foot lies with the plantar surface uppermost, the left with that surface outermost.

The rectrices and remiges have just protruded, while papillæ marking the future major coverts are plainly to be seen on the cubitus and manus; no other papillæ, however, can be distinguished. The beak is shorter than in the corresponding stage of *B. rhinoceros* and rather deeper. A small deposition of calcareous salts at the extreme tip of the upper mandible is noteworthy; I have not noticed it in *B. rhinoceros* either at this or the subsequent stage. The lower mandible bears the minute papillæ on its anterior edge already alluded to. The opening of the oil-gland, with a surrounding ring of feather-papillæ, is apparent. The foot is as already described.

Dimensions.—Total length 159; upper mandible 12; lower mandible 21; antebrachium 20; tibia 19; tarsus 16; hallux 7; 3rd digit 6.5.

Stage 3.—Newly-hatched nestlings of *Buceros rhinoceros* and *Rhytidoceros undulatus*. (Pl. VIII. figs. 4 & 5.)

Buceros rhinoceros.—The conical shape of the head, the entire absence of feathers, and the loose and closely-wrinkled skin are the most noteworthy features at this stage. The

dense wrinkles of the skin, most prominent on the head and neck, render it a matter of great difficulty to define the exact boundaries of the feather-papillæ tracts, but, so far as I can make them out, they are as follows:—A *pteryla capitis* clothes the whole of the head with the exception of the anterior half of the eye and a small area below the gape; dorsally this *pteryla* can be faintly distinguished as running into the *pt. dorsalis*, which runs down to the pygidium, broadening in the lumbar region and forking before its termination. The *pt. ventralis* starts from the throat, runs down the ventral aspect of the neck, and bifurcates at the junction of the neck and body, the branches running down to the end of the sternum. A small *pt. femoralis* is just visible. The tips of the ten rectrices, of the eleven primaries, and of ten cubitals have made their appearance, while on the manus the upper *tectrices majores*, and on the cubitus the upper *tectrices majores* and *mediæ*, are to be seen slightly protruding. An area, apparently devoid of papillæ, is present on each side of the neck (see later). The eyes are still closed, the nostrils lying close under them. The beak is as already described; the tongue is relatively much larger than in the adult, occupying the greater part of the floor of the mouth. The pygidium projects upward and anteriorly, a position exactly opposite to that which it occupies in the embryo; the opening of the oil-gland is now visible; the cloacal aperture is very prominent. The foot is less symmetrically disposed than in the previous stage, the plantar surface being turned somewhat outward. As before, the “heel” is very prominent; it is chiefly on this part of the foot that the nestling rests, not on the plantar, as erroneously figured in Wallace’s ‘Malay Archipelago’ (p. 105 of the 1894 edition). Both “heel” and planta are covered with small granular scales. The portion of the foot in between has larger, though still granular, scales, which, however, in the adult become scutes. The second digit is bound by one joint, the fourth by two joints, to the third digit.

Dimensions.—Total length 158; upper mandible 18; lower mandible 26; neck 30; cubitus 20; manus 13; tibia 23; tarso-metatarsus 19; hallux 9; 3rd digit 11.

Rhytidoceros undulatus.—Of this species I have two young nestlings, one slightly older than the other; both are almost identical in their external characters, and differ but little from the nestling of *B. rhinoceros* just described. The beak is deeper and more sinuous in outline than in *B. rhinoceros*; a deposition of calcareous salts on the tip of the upper mandible marks the shell-breaking junction of this part; the lower mandible is less abruptly truncated, and the small papilla has disappeared in the older of the two specimens. The rectrices and remiges are a trifle more advanced than in *B. rhinoceros*; but the distribution of the feather-papillæ and their state of development is the same.

Dimensions of Specimen No. 1.—Total length 155; upper mandible 21; lower mandible 31; neck 33; antebrachium 19; manus 18; tibia 35; tarso-metatarsus 27; hallux 10; 3rd digit 9·5.

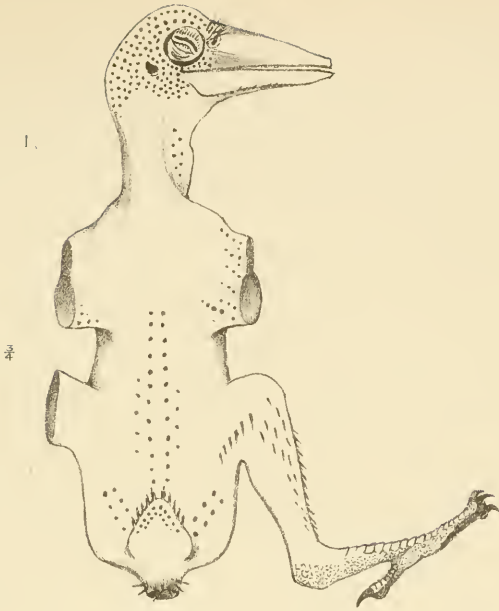
Dimensions of Specimen No. 2.—Total length 165; upper mandible 24; lower mandible 34; neck 35; antebrachium 24; manus 22; tibia 41; tarso-metatarsus 27; hallux 11; 3rd digit 9·5.

Stage 4.—One six-weeks-old nestling of *Buceros rhinoceros*.
(Pl. IX. figs. 1, 1 a, & 2.)

I, unfortunately, have nothing intermediate between this and Stage 3; but I have waited so long for material to fill this gap that I quite despair of ultimate success. The head is no longer conical in shape, the beak is much longer proportionally to its depth, and the tongue is proportionally smaller. The cloacal aperture is most remarkably prominent, protruding very considerably beyond the general contour of the body. The pygidium is still turned forward and consequently conceals the oil-gland. The skin is still very loose and much wrinkled, but the feathers have pushed their way out in certain areas, now to be described* :—

Pteryla capitis covers the top, back, and sides of the head, and runs for a short distance down the back of the

* In Plates VIII., IX., & X. only those feathers which have actually made their appearance are drawn; the feather-papillæ are disregarded.



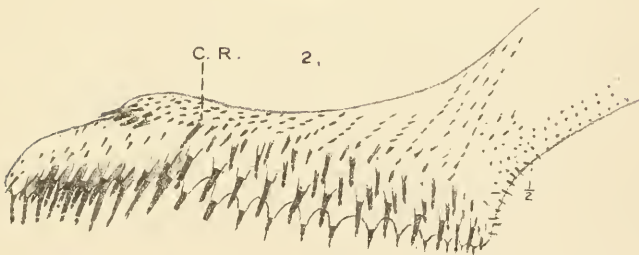
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1 a.

X 12.



C. R.

2.

$\frac{1}{2}$

neck. The skin between the rami of the mandibles is devoid of feathers, save for a few bordering bristles. The eyelids are provided with eyelashes, those of the upper lid being the more strongly developed; they have the same structure as the rictal bristles (*cf.* Pl. IX. fig. 1 *a*), but are singly disposed, not arranged in groups. These filoplumes are either fine single bristles, or double, or else terminate in a somewhat trident-like fashion.

Pt. colli.—Of this future well-developed and solid tract very little can yet be seen, neither the *pt. spinalis* nor the *pt. ventralis* having absolutely established their connection with the *pt. capitis*. Ventrally a few minute tips can be seen on the lower part of the neck; laterally not even feather-papillæ can be distinguished.

Pt. spinalis.—The feathers forming this tract are not far advanced, none being actually visible above the middle of the back. The tract quickly broadens out, then narrows again, and finally spreads over the pygidium to fuse with the coverts of the rectrices. A short narrow branch is sent up on each side towards the *pt. femoralis*, from near the termination of the *pt. spinalis*.

Pt. ventralis commences at the base of the neck; its connection with the *pt. colli* is, however, not yet established. Almost immediately the tract forks, the branches running down as far as the lower edge of the sternum. The lower feathers are white. I will here just notice a short tract which runs from the proximal third of the humerus, downward towards the *pt. ventralis*. I shall have more to say concerning this later on.

Pt. humeralis.—Continuous with the *pt. alaris*.

Pt. ani.—A ring of feathers surrounding the prominent anus.

Pt. femoralis.—A few, but well-developed, feathers running into a strong *Pt. cruralis*, the feathers of which are white.

Pt. uropygii.—The oil-gland is densely tufted.

Pt. alaris.—(Pl. IX. fig. 2.)

Metacarpo-digitals.—The tips of the 2nd to the 11th have appeared, as is the case with the cubitals; the tip of the 1st

metacarpo-digital has not yet pushed through, and, as there is no carpal diastema, this feather looks as if it belonged to the cubital series. Nos. 3, 4, & 5 are the longest.

Cubitals.—Thirteen can be distinguished; they decrease in size proximally. Only the sheaths of Nos. 1 to 7 have appeared, while of Nos. 8-13 not even these are to be seen.

Tectrices :—

T. majores.—Well developed on the dorsal surface; on the manus there are none ventrally, on the cubitus 12 weak feathers.

T. mediae.—Nos. 1 & 2 (dorsal) are absent on the manus, while ventrally 9, 10, and 11 only occur. On the cubitus they are well developed dorsally, but ventrally are absent.

T. minores.—On the manus dorsally one row (Nos. 4-11), ventrally only one is present (No. 2). On the cubitus the series begins with two rows and proximally widens out to five, the second, third, fourth, and fifth rows terminating abruptly and leaving a bald patch just above the elbow. On the ventral surface there are none.

T. marginales.—On the manus there are two rows on the dorsal, and two on the ventral surface, one row of each series being on the pre-axial border. On the cubitus, dorsally, the series begins with eight or nine rows: at one point they do not reach the pre-axial border of the patagium; ventrally there are three rows.

Parapteron is singularly well marked; it is continuous with the *T. majores mediae* and *minores*.

Hypopteron.—Non-existent.

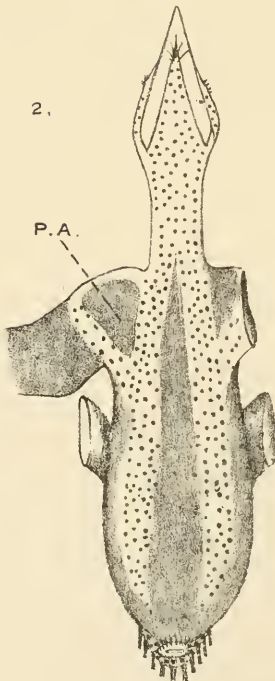
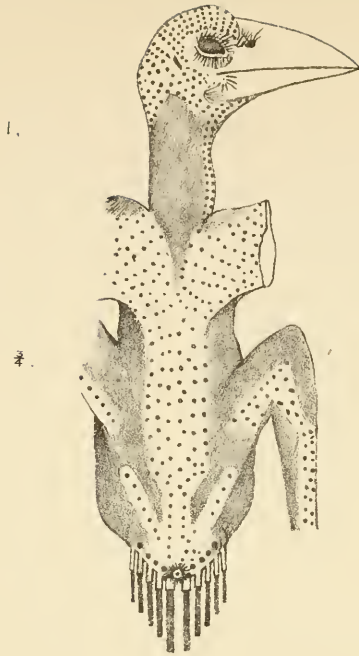
A *carpal remex* is present.

Ala spuria with all the coverts well developed and continuous with the coverts of the cubitus.

Pt. caudalis.—Rectrices with the dorsal and ventral coverts developed.

The foot has now assumed the definitive shape, the toes being proportionally larger, the planta broader, and the heel less prominent. The ventral scutes have not yet appeared.

Dimensions.—Total length (from tip of beak to base of



pygidium) 386; upper mandible 61; lower mandible 72; antebrachium 74; manus 57; tibia 98; tarso-metatarsus 68; hallux 21; 3rd digit 35.

Stage 5.—Two advanced young of *Anthracoceros malayanus*.
(Plate X.)

These two young birds have so nearly assumed the general appearance of the adult that I have but little to remark. The upper mandible is very deep, if measured across the nostril, which is much further from the culmen than in *Buceros rhinoceros*. The pygidium is turned downward, and the mouth of the cloaca is still very prominent. The foot is exactly the same as in the adult: that is to say the ventral scutes have appeared, one line of granular scales separating them from the dorsal series.

The pterylosis is interesting, inasmuch as not even yet have all the feathers appeared through the skin.

Pteryla capitis.—This is very much as in Stage 4, though the feathers are naturally much longer. The posterior half of the eye and the base of the mandible are naked.

Pt. colli.—The back and sides of the neck are still quite naked, but ventrally the tract is very well developed, occupying the whole of the space between the rami of the mandibles and running into the *pt. ventralis*. This very late appearance of the lateral and ventral parts of the *pt. colli* is interesting as being possibly evidence of a former but now obsolete arrangement. In the adult the feathers on these parts are small and ill-developed, while in *Rhinoplax vigil* the whole neck is quite bare ('Dictionary of Birds,' Newton & Gadow, p. 434); whether or not this latter arrangement is the more primitive it is not easy to say.

Pt. spinalis.—The apterium of the neck extends down the back as far as a point between the shoulders; a very small apterium in the adult persists at this point. The *pt. spinalis* is perfectly continuous with the *pt. humeralis*, no apterium separating them; shortly before reaching the pygidium the tract narrows down to a row of two feathers deep, and then spreads over the pygidium, fusing with the coverts of the

rectrices. The two upwardly-diverging tracts noticed in Stage 4 are present here also; in the adult they join the *pt. femoralis*.

Pt. humeralis.—Dorsally it is continuous with the *pt. alaris* and *pt. spinalis*; in the adult it runs over on to the ventral surface to fuse with the *pt. ventralis*; but at present this connection is not yet set up.

Pt. ventralis is in two halves, perfectly separate from each other; the *pt. colli*, forking just before its termination, runs into each half. A great increase in the length of the two ventral branches may be noted when this stage is compared with Stage 4. At the level of the knee (with the leg drawn up) each branch of the ventral tract sends upward and outward towards the proximal end of the humerus a sparse and narrow tract, the commencement of which was just indicated in Stage 4. In the adult these two narrow tracts sweep round over the point of the shoulder to join the *pt. humeralis* and *pt. ventralis* at the point of fusion of those two tracts; an oval island-like apterium is consequently left, which apterium I propose to call the *apterium pectorale*; though not completely formed at Stage 5, I have in Pl. X. fig. 1 indicated its future outline by a line.

Pt. alaris.—Save that the under coverts are no further developed than in Stage 4, the wing has assumed the adult appearance, and the birds must be quite capable of flying for short distances.

The other pteryllæ call for no special notice.

General Summary.

The nestlings of the Bucerotidæ here examined are so highly specialized, no doubt as a result of the extraordinary habits of nidification, that a study of their external characters has not proved of any taxonomic value, though possibly the nestlings of the Upupidæ and Irrisoridæ might exhibit characters which would help to bridge over the gap between these families and their allies, the Hornbills.

The large dorsal apterium of the Upupidæ is in the adult Hornbill represented only by a minute apterium between the

shoulders, and though its extent is considerably greater in the nestling of *Anthracoceros malayanus* (Stage 5), it is there correlated with an almost entirely naked neck, an arrangement which I am inclined to think primitive. The long *apt. coll. ventr.* of the Upupidæ is represented by a short expanse above the junction of neck and body in the young of *A. malayanus*; but the branching of the ventral pteryla in the Upupidæ is in all Hornbills quite unparalleled; for, as shown on p. 543 and p. 546, the branch of the ventral tract which outwardly bounds the *apt. pectorale* arises from a point low down on the tract to run upward, while in the Upupidæ it arises at the upper extremity to run downward. The junction of the *pt. humeralis* and *pt. femoralis* with the dorsal tract is also quite opposed to the arrangement in the Upupidæ.

The Nesting-habits, &c., of Buceros rhinoceros.

By C. HOSE.

The nest is always built in the hollow of a large tree—the hollow, be it noted, being always due to disease of the tree or to the ravages of termites, not to the personal labours of the birds. The bottom of this cavity is often plugged by a termite-nest and accumulation of decayed wood, and on the upper surface of this is made the nest, a very rough-and-ready structure, composed simply of the feathers of the female. The hollow of the tree communicates with the exterior air by means of a long aperture, which, just before the period of incubation, is closed up almost entirely by the male, simply leaving a long open slit, up and down which the beak of the enclosed female can move. The substance used in thus closing the aperture closely resembles some vegetable resin, and is probably composed of a gastric secretion combined with the woody fragments of fruit. It should be noted that this slit is always in close proximity to the nest, so that the female can easily protrude her beak for food without moving from her sitting position. During incubation the male bird supplies the female with food in the form of pellets of fruit, seeds, insects, portions of reptiles,

&c., the pellets being enclosed each in a skin of rubber-like consistency. While feeding the female, the male clings to the bark of the tree, or sits on a branch if conveniently near, and jerks these pellets into the gaping beak of the hen, two to four pellets forming a meal. During mastication (for it is a mistake to suppose that the Hornbills always bolt their food entire) some fragments of the pellet fall to the ground; any seeds which these fragments may contain take root, germinate, and sprout, and the natives can approximately judge of the date of incubation by the age of the seedlings. When these are four-leaved, the eggs have been hatched out for two or three weeks. At this stage, though not always so early, the mother-bird leaves the nest, breaking down the gluey substance with her beak to effect an exit; having left the nest, the aperture through which she left is carefully closed up again, leaving the slit as before, and now both male and female devote their energies to feeding the young birds, who in course of time follow the example of their mother and leave their place of imprisonment. It is more than probable that this gluing up first of the mother-bird and her eggs and afterwards of the nestlings alone is solely a means of protection against predaceous carnivora (*Paradoxurus*, *Hemigale*, *Arctogale*, *Arctictis*, &c.); the fact that I have shot a specimen of *Hemigale hardwickei* in close proximity to a Hornbill's nest lends support to this view. One, two, or three eggs are laid: the egg of *B. rhinoceros* is white closely mottled with brown, giving a pepper-and-salt appearance; that of *Anthracoceros malayanus* is white, a specimen in my possession measuring 47 mm. \times 32 mm. The nesting-season is during May and June, and it is noteworthy that the birds, if undisturbed, return to the same nesting-place every year. The saplings at the foot of the tree, sprung from seeds dropped in the first year of pairing, afford signs to the natives of the number of years during which the tree has been occupied. If during pairing or incubation the female, or female and young, are destroyed, the male takes to himself another mate and repairs to the same nesting-place; if, however, the male and female are

destroyed, the nest is never re-occupied by other pairs. An interesting incident was observed while on Mount Dulit. Espying on a tree the external signs of a Hornbill's nest, and a male *Buceros rhinoceros* perched close by, I shot the male, and while waiting for my Dyak collectors to make a ladder up the tree to secure the female, I observed several young male birds fly to the nest and assiduously ply the bereaved widow with food, a fact which seems to indicate a competition in the matrimonial market of the bird-world as severe as that among human beings. It is no easy matter to procure embryos or nestlings of Hornbills, for the natives are inordinately fond of both as articles of diet, and, further, are always anxious to secure the tail-feathers of the adults to adorn their war-coats and hats. The native method of catching the female during incubation is ingenious, though decidedly brutal. The tree is scaled, the resin-like substance is broken away, and the frightened bird flies from her nest up the hollow trunk of the tree, but is ignominiously brought down by means of a thorny stick (the thorns pointed downward), which is thrust after her and twisted about until a firm grip in her plumage and flesh is obtained. The Dyaks, never very faithful observers of nature, believe that the female is shut up by the male so that, after hatching out her eggs, she may die, the maggots in her putrefying body affording food for the young. One very curious habit of *Buceros rhinoceros*, which I have not hitherto seen noted, is the rapid jumping up and down on a branch with both feet together. This jumping motion is imitated by the Kyans and Dyaks in their dances, the figure being known to the Kyans as "wan blingong."

XLVI.—*An Ornithological Expedition to the Zambesi River.*

By BOYD ALEXANDER, F.Z.S.

(Plate XI.)

WITH the intention of investigating thoroughly the ornithology of the Zambesi region, we set out from Chindi on July 18, 1898, in one of the river steamers, which was to